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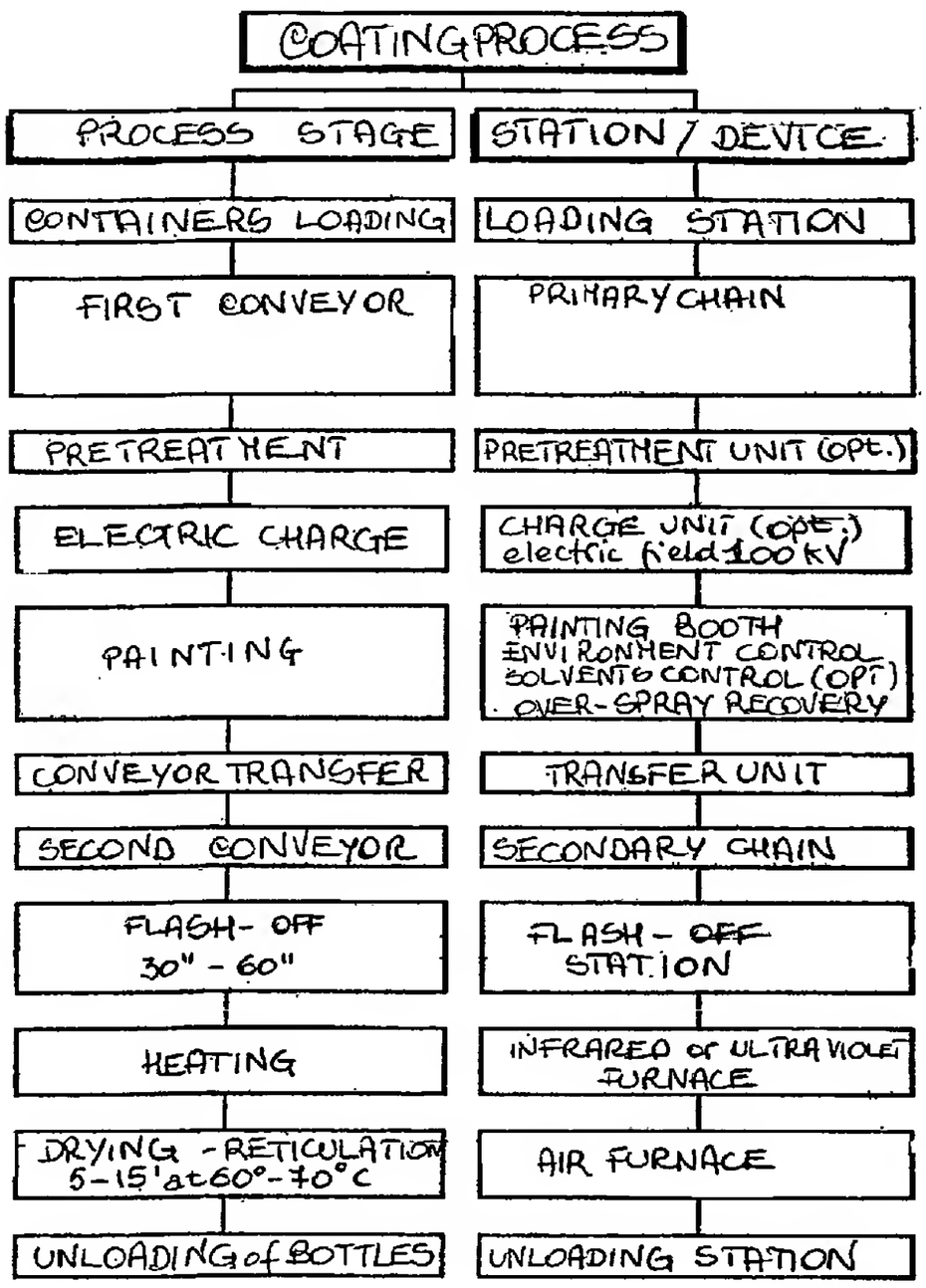
(54) Title: A DEVICE AND METHOD FOR COATING CONTAINERS



(57) Abstract: A plant (1) for coating plastic bottles comprising many processing stations where the different phases of the coating process take place, and two distinct continuous chains (3, 9) for conveying the bottles through the processing stations. Said stations are located on two different levels. Transfer carrousels transfer the bottles from one chain to the other. The reticulation furnaces are positioned on the higher level.

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A DEVICE AND METHOD FOR COATING CONTAINERS

Technical Field

This invention relates to a device for coating plastic containers. More particularly, it relates to coating, for example, PET bottles made through blow moulding.

Prior art

Today, the production of foodstuff containers in different shapes and sizes – for example, plastic bottles or pots made of PET, PP, HDPE, or PEN – takes place in production plants that carry out a series of steps. Normally, these steps include at least a blow-moulding phase to create the container in its final form, starting from a pre-moulded workpiece. In special cases, the blow-moulding phase is followed by a coating operation using products particularly suited to make the container gas-tight, such as to oxygen or carbon dioxide. The question of the permeability of the container walls to gas is particularly important, for example, when dealing with bottles that must contain carbonated drinks, but also in the case of other foodstuff or drinks that are affected by oxidation, decreasing shelf life. In some cases, containers are painted for decorative purposes.

The coating plants can be of very different sizes, also depending on the productive capacity of the plant that can vary from hundreds to several thousands of bottles per hour. Today, these plants are highly automated; they comprise a station for loading the containers to be painted, a coating station, and a paint reticulation station, for example, equipped with furnaces suitable for the type of paint used in the process. In these plants, containers are moved from one station to another by means of conveyor chains equipped with gripping devices, especially the so-called chucks, or on conveyor belts.

These plants generally suffer from contamination caused by different soiling agents – such as dust, particles of lubricant, or airborne particles – that can adhere to the surface of the container or bottle when the paint is still fresh, compromising the quality and the uniformity of the paint. The problem of contamination from lubricants is particularly felt in drying or reticulation furnaces: this is where the conveyor chain requires more lubrication than in the other parts of the plant; however, the higher temperature of the furnace makes the lubricant more volatile, and, thus, more particles are dispersed.

Technological advances have lead to the development of coating or paint products for plastic containers that are evermore effective in lengthening the shelf life of the foodstuff contained in the container or bottle. However, said coating or paint products require more complex, more time consuming, and more operations than in the past. This fact negatively affects the production speed of said plants; whilst, the production speed should be in line with the probably high-output blow-moulding plants of containers. Hence, in order to use a coating plant with a high-output blow-moulding plant it is necessary to make large coating plants with large capacity stations that occupy a lot of space and, thus, require large investments. In some urbanized areas, these costs may be very significant.

Another problem that arises in coating plants concerns adaptation: adapting to different types of processes that can be necessary when the plant uses coating products with different properties, or adapting the production of the coating plant to the different productive capacities of the container blow-moulding plants, which supply containers to the coating plants directly or after storage.

Objects of the Invention

It is an object of this invention to provide a plant for coating containers or other plastic objects, such as bottles, that resolves the aforementioned problems, implementing high-quality coating processes, in the shortest time possible, compatibly with the coating product.

It is another object of the invention to create a coating plant that is modular, expandable in some of its components, and adaptable to different production speeds of plastic containers, while remaining compact in its dimensions.

It is another very important object of the invention to create a coating plant that accomplishes the coating process minimising contamination of the coated containers.

In accordance with a first aspect of the invention, these objects are achieved by means of a coating plant for containers, especially plastic bottles, suitable to carry out a coating process involving many processing stations that carry out the different phases of said coating process. Said plant features a first continuous container-conveying device equipped with several gripping elements suitable to secure reversibly said containers. Said first continuous conveying device is apt to

feed said containers to be coated through at least one of said many processing stations. Several of said processing stations are positioned on a first level while others are positioned on a second level above said first level.

These objects, in accordance with another aspect of the invention, are achieved by means of a method for coating plastic containers, implemented by means of the coating plant mentioned above, comprising the following steps:

a) Loading said containers onto a first continuous conveying device,

b) Pre-treating said containers at a pre-treating station,

c) Coating containers by applying a predetermined paint,

d) Transferring said containers from said first continuous conveying device to a second continuous conveying device,

e) Feeding said containers through a flash-off station for a predetermined amount of time,

f) Feeding said containers through a reticulation station for a predetermined amount of time,

g) Unloading said containers from said second continuous conveying device.

Thanks to the innovative characteristics of the plant according to the invention, the plant can be adapted to the most different production needs, for example, ranging from 6000 bottles per hour to 36000 bottles per hour. It is possible to increase the number of paint reticulation or drying furnaces without redesigning the plant and without large structural interventions, maintaining almost unaltered the surface occupied by the plant.

The fact of providing separate container-conveying lines – essentially, creating a wet and a dry area depending on whether or not the containers are covered with wet paint, respectively – also involves cost savings because the dry area can be served by simpler, and consequently less expensive, container-gripping devices. The risk of contaminating the containers with residues or airborne dust is minimized; consequently, this improves the quality of the product, the performance of the barrier offered by the paint, and the attractiveness of the containers. Another important advantage is that it is easier to clean the container-gripping devices that circulate only in the wet area and are dirty with paint. This is accomplished by including a line station in the plant for cleaning the dirty, container-gripping

devices; this has the additional advantage of reducing plant stoppages required to carry out maintenance work or replace the too dirty or worn devices.

Brief description of the drawings

Other advantages of the invention will be readily apparent from the more detailed description of a particular version of the device, given as a nonlimiting example and in conjunction with the following accompanying drawings:

- **Fig. 1 shows a block diagram of a coating process implemented by means of a coating plant in accordance with the invention;**
- **Fig. 2 shows a schematic three-dimensional view of a coating plant in accordance with the preferred variant of the invention;**
- **Fig. 3 shows a plan view of a first part of the plant of Fig. 2;**
- **Fig. 4 shows a plan view of a second part of the plant of Fig. 2;**
- **Fig. 5 shows a plan view of a particular variant of the plant of the invention.**

Description of preferred embodiments of the invention

Fig. 1 shows a schematic view of a coating process of plastic containers such as, but not exclusively, PET bottles. In the description the terms paint or coating are used indifferently for the purpose of the invention. Said process comprises the phases described below. The containers are made by a known type of blow-moulding plant, not described in this description, and are transported by means of a known type of conveyor to a loading station of the coating plant of the invention. This coating plant feeds the bottles at the appropriate feed rate through a pre-treatment station where the bottles are treated, for example, by subjecting them to a stream of deionized air in order to eliminate any residual electric charges, dust, etc. that deposit on the external surface of containers in PET, PP, HDPE, etc. In this station, it is also possible to carry out an operation that consists in activating the surface with more or less known methods – for example, flame hardening, the

corona effect, plasma, or UV – in order to increase the wettability of the container before applying the paint, and, thus, obtain better results.

The means of transport are a part of a first conveying circuit of closed-ring type.

When required by the coating process, the next phase involves subjecting the bottles to an electric charge in an electric field, for example of approximately 100kV, in order to charge the bottles with an appropriate electric charge. Then, the bottles are forwarded to the next phase, which takes place in the coating station. Coating can be carried out preferably through spray coating; however, other coating processes can also be used whenever these are suitable for the particular product chosen to coat the bottles.

After completing the coating phase, the bottles are transferred from the first conveying circuit to a second conveying circuit that moves the bottles to a flash-off area for a predetermined amount of time, normally ranging from a few seconds to 60 seconds and over, which depends on the used type of paint or product. Then, the bottles are fed through a furnace or set of furnaces of reticulation for an amount of time that also varies according to the used type of paint. A particular coating product, marketed as Bairocade®, for PET bottles requires a reticulation time that varies between 5 to 15 minutes at a temperature of approximately 60°C-70°C. When this phase has been completed, the bottles are unloaded and sent off for other uses.

In order to implement the described process in the most cost effective, quick, and efficient way, a preferred version, according to an essential aspect of the invention, of a coating plant 1 is used, which is shown schematically in Figures 2 through 5. The different stations of the plant 1 are arranged on two over-and-under levels, are appropriately oriented, and are reciprocally placed in order to achieve maximum efficiency and cost effectiveness in terms of the operation of the whole plant 1.

This plant comprises, at the lower level, a station 2 for loading the bottles, which is supplied by a bottle-making machine or an appropriate system. This station is served by a continuous chain conveyor 3, or other similar system, for transporting the bottles that moves in the direction shown by the arrow 4; the bottles to be painted are placed on the chain and fastened by means several fastening

supports. The plant 1 also includes a pretreatment station 5, followed by, in the feeding direction of the conveyor chain 3, a spray-coating station 6 where the paint is applied, for example but not necessarily, by means of spray nozzles. Coating can also be carried out by immersing the containers in dip tanks, or by flow coating. However, other coating processes can also be used depending on the desired results.

Upon exiting the coating station 6, the plant includes a station 7 for changing the conveyor chains. Using a wheel 8 system, the just-painted bottles are transferred from the gripping devices of the chain 3 to a second chain 9, which is also equipped with bottle-gripping devices.

The first chain 3 freed from the bottles is immediately fed through a cleaning station 10 where the paint residues can be removed when no paint reticulation has taken place. The cleaning station is thus simpler to design and to run, since it is not necessary to clean dry paint but only still-fresh residues. This decreases the running costs of the plant. The cleaning station 10 is preferably positioned on the same level of the spraying station 6. The conveyor chain 3, after passing through the cleaning station returns to the loading station 2 where other bottles to be painted are loaded continuously.

The second chain 9, after having gripped the painted bottles, passes through a solvent-evaporating station 11, also called flash-off station, of the known type. For example, this station is made up of a pressure and room-temperature chamber where the bottles are kept for the time required by the vector of the paint, normally a solvent or water if the product is water based, to evaporate adequately in order to complete the next phases of the process optimally. This step avoids, for example, the formation of bubbles during the next passage through the furnace; furthermore, the paint could need a certain time to cover the surface homogeneously. The flash-off station 11 is preferably placed on the same level as the coating station 6. At the exit of this station, the chain 9 rises to the next level of the plant.

Then, the conveyor chain 9 feeds the bottles through the drying stations located on the higher level. Generally, these stations are hot-air or infrared or other type of reticulation furnaces apt to dry the particular paint used in the process. This phase,

for example, can also include a pre-heating station 12 formed by an infrared furnace, which brings the bottles to the required reticulation temperature, and by one or more hot-air furnaces 13' to 13^{IV}, which maintain the bottles at the right temperature for the time necessary for the paint to reticulate or dry.

Once they have left the drying station, the bottles are transported to the unloading station 13, placed on the lower level of the plant, where they are removed by the gripping devices and sent, on other conveyors, to the next processing stations, packing, etc.

In a variant of the plant 1, the flash-off station 11 is placed on a higher level and, thus, the chain 9 rises at the exit of the transferring station 7.

In this way, the first conveyor chain 3 only serves the wet area of the coating plant, meaning the part where the paint is not yet in a reticulation phase, while the second chain 9 conveys the bottles only in the dry part of the plant, meaning the one where the paint has started to dry and/or reticulate. In this way, the bottle-gripping devices of the chain 9 can be designed with a less complex structure because they are not subject to the action of the paint; this leads to significant cost savings. Since the wet area of the plant 1 is smaller than the dry area, the chain 3 is shorter than the chain 9, and, thus, requires fewer bottle-gripping devices attached to the chain, leading to additional savings in terms of investment.

According to a particular aspect of this invention, the bottles to be painted are fed through segments of the plant 1, for example through the coating station 6, hung on the conveyor chain 3, meaning below the line of movement of the chain to which they are fastened by their open end. In some other segments of the plant 1, the same bottles are positioned upside down with their end open, by which they are attached to the gripping devices of the respective chain, placed below, meaning the bottles above the line of movement of the chain. Optimally, the segments where the bottles travel in the upside down position include the drying station 12.

In this way, the body 13 of the conveyor chain 1 does not get dirty with drops of paint that fall on the painted bottles in the segment of chain immediately after coating, or does not get dirty with paint in the coating station. In fact, if the body of the chain in the coating station were on a lower level than the bottles, there would

be a large amount of sprayed paint on it. Since in the drying and/or reticulation furnaces the bottles are fed with fastening supports above the moving line of the chain 9, these do not get dirty with particles or drops of lubricant or other dirt particles that fall on the chain. In this way, the chain can also be lubricated inside the furnaces where the need for lubrication is greater and, thus, the risk of lubricant contamination is usually greater since the higher temperature of the furnace makes the lubricant less viscous and more fluid.

Turning over the bottles is accomplished optimally, but not necessarily, where the chain 9 rises from the lower level of the plant 1 to the higher level. In this way, it is possible to arrange, in a very simple manner, the conveyor chain on two levels as described above, which also reduces substantially the surface covered by the plant. This is particularly relevant in the case of plants with a high productive capacity that have very long conveyor chains because the time the bottle stays in each work station of the plant 1 must be adequately long.

The plant 1 is also equipped with other stations accessory to the main coating process, in particular: a station 14 for conditioning air able to handle considerable airflows, a station 15 for storing and preparing paint, and a station for removing the sediment 16 from the water for disposing of the used solvents and paints, meaning not deposited on the containers during spraying, the so-called overspray.

CLAIMS

1. Coating plant (1) for containers, especially for plastic bottles, suitable for carrying out a coating process, comprising a plurality of processing stations, wherein phases of the coating process are carried out, a first continuous conveying device (3) of said containers provided with a plurality of gripping devices adapted to hold reversibly said containers, wherein said first continuous conveying device (3) is suitable to convey said containers to be painted through at least one of said plurality of processing stations, characterised in that some of said processing stations are positioned on a first level while others are positioned on a second level above said first level.
2. A plant according to claim 1 wherein there is provided a second continuous conveying device (9), and means (7) for transferring said containers from said first (3) to said second (9) continuous conveying device.
3. A plant according to claim 2 wherein the transferring means (7) of said containers are placed on said first level, and said second (9) continuous conveying device conveys said containers from said first level to said second higher level.
4. A plant according to claim 3 wherein said containers are fed through one or more first stations in a position which is lower than the level of the moving line of said second continuous conveying device and through one or more second stations in a position which is higher than the level of the moving line of said second continuous conveying device.
5. A plant according to one or more of the previous claims wherein said plurality of processing stations comprises a loading station (2) for said containers, at least one coating station (6), a flash-off station (11), a cleaning station (10), one or more paint reticulation and/or drying stations (12, 13), and an unloading station (14) for said containers.
6. A plant according to claim 5 wherein said one or more paint reticulation and/or drying stations (7,8) are positioned on the second level.
7. A plant according to claim 1 wherein each of said continuous conveying elements (3, 9) is a chain.

8. A method for coating plastic objects, implemented by means of a coating plant according to one or more of the previous claims, comprising the following phases:

a) Loading said containers onto a first continuous conveying device (3);

b) Pre-treating said containers at a pre-treating station;

c) Coating containers by means of a predefined technology for applying a predefined paint;

d) Transferring said containers from said first continuous conveying device (3) to a second continuous conveying device (9);

e) Feeding said containers through a flash-off station for a predetermined amount of time;

f) Feeding said containers through a reticulation station for a predetermined amount of time ;

g) Unloading said containers from said second continuous conveying device (9).

9. A method according to claim 8 wherein said predefined technology for applying the paint on the containers is spray coating and/or immersing into a dip tank and/or flow-coating.

10. A method according to claim 9 wherein, after the pre-treating phase, said containers are immersed in an electric field of predefined intensity in order to charge the bottles with an appropriate electric charge.

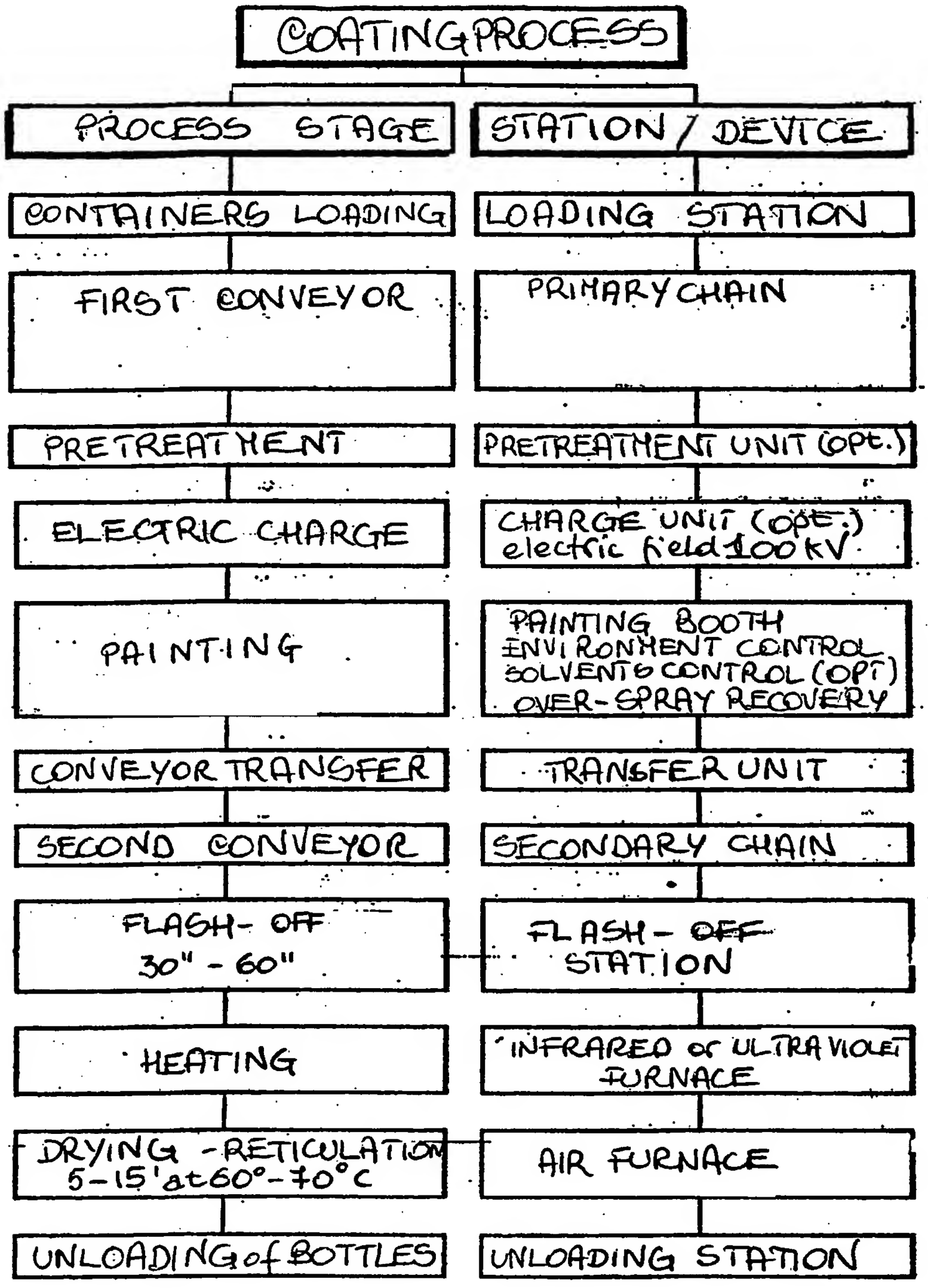
COATING PROCESS
PROCESS STAGE
STATION / DEVICE
CONTAINERS LOADING
LOADING STATION
FIRST CONVEYOR
PRIMARY CHAIN
PRETREATMENT
PRETREATMENT UNIT (Opt.)
ELECTRIC CHARGE
CHARGE UNIT (OPE.) electric field 100 kV
PAINTING
PAINTING BOOTH ENVIRONMENT CONTROL SOLVENTS CONTROL (OPT) OVER-SPRAY RECOVERY
CONVEYOR TRANSFER
TRANSFER UNIT
SECOND CONVEYOR
SECONDARY CHAIN
FLASH-OFF 30" - 60"
FLASH-OFF STATION
HEATING
INFRARED or ULTRA VIOLET FURNACE
DRYING - RETICULATION 5-15' at 60°-70°C
AIR FURNACE
UNLOADING of BOTTLES
UNLOADING STATION

Fig. 1

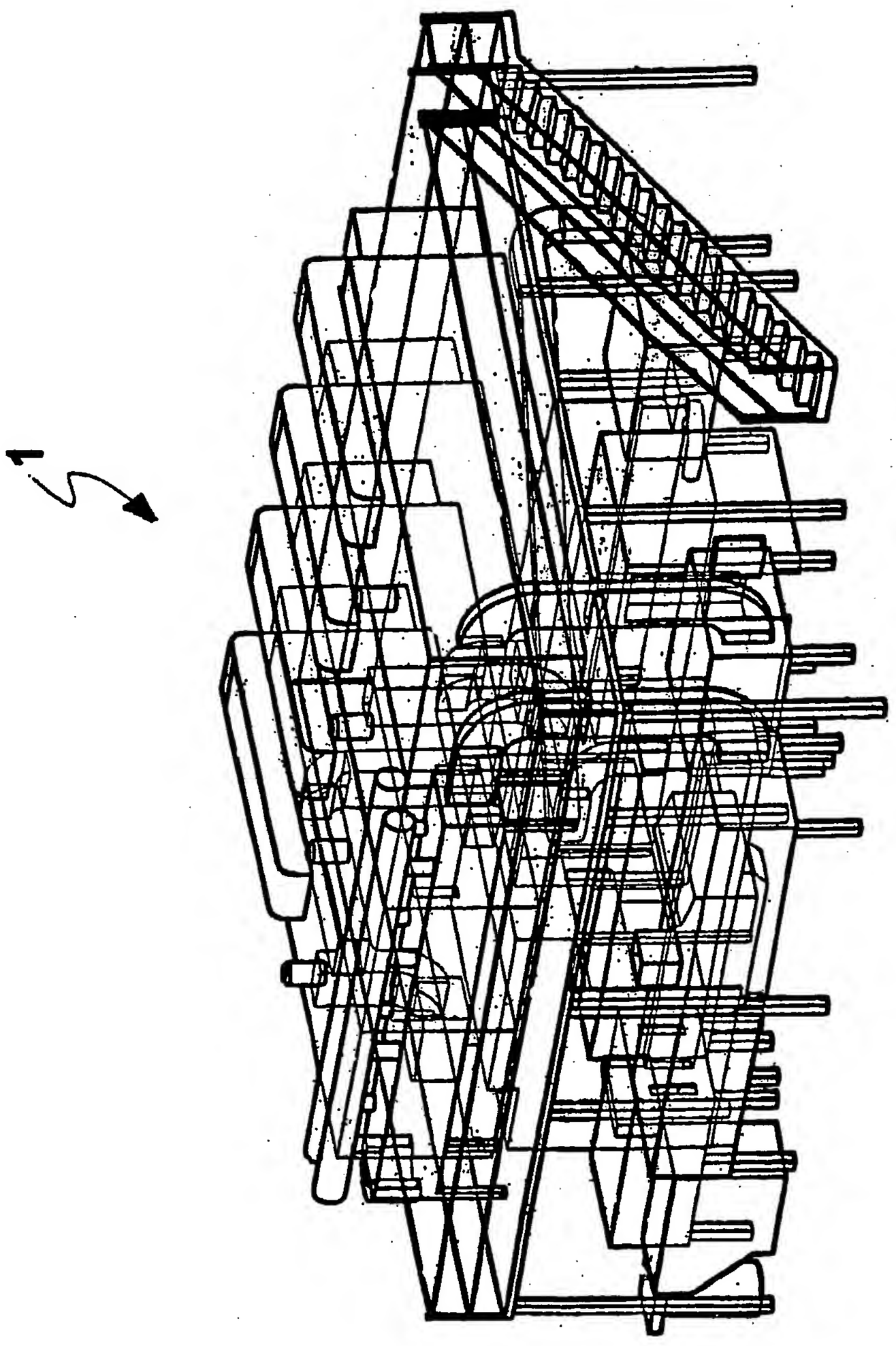

Fig. 2

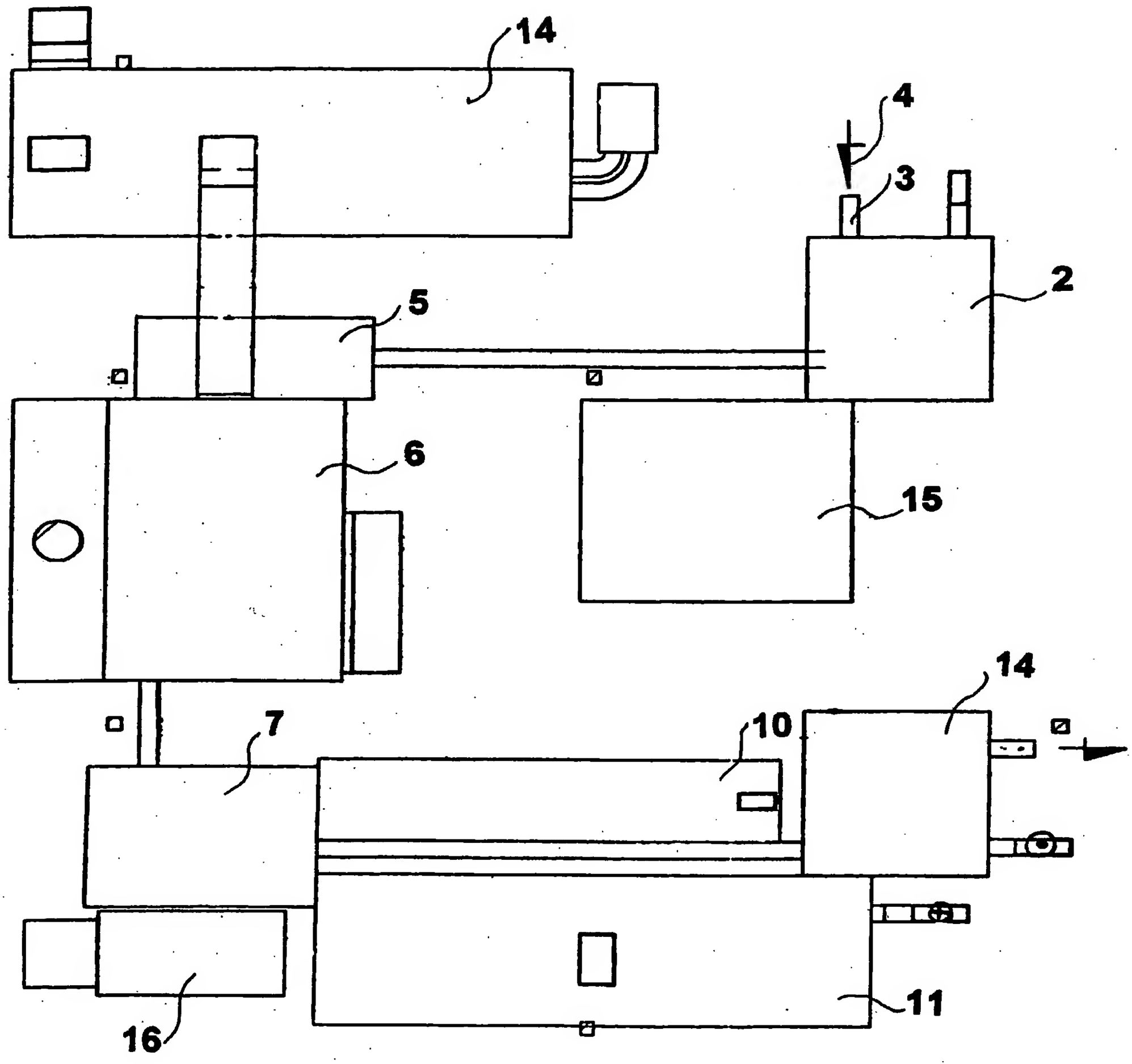

Fig. 3

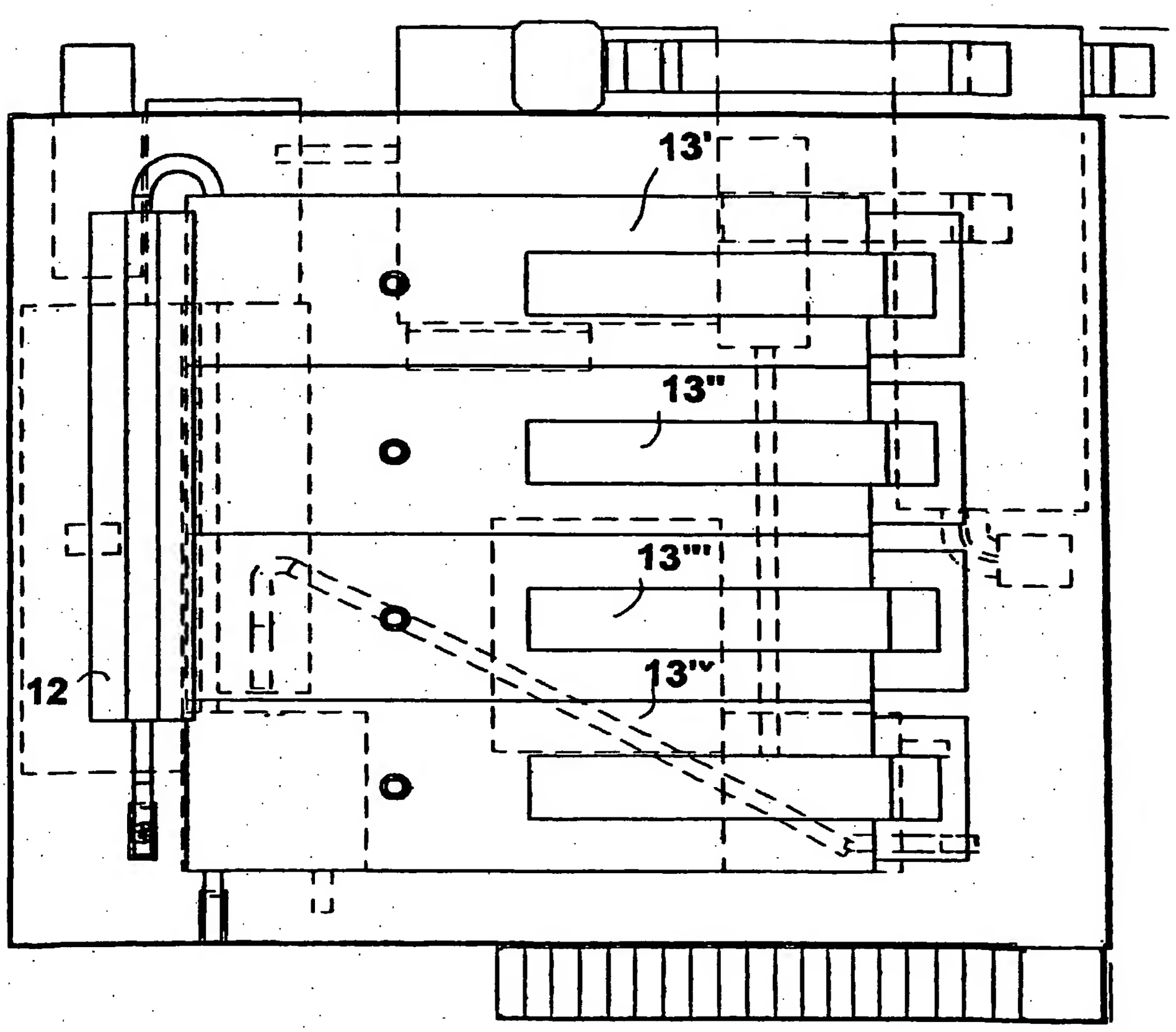

Fig. 4

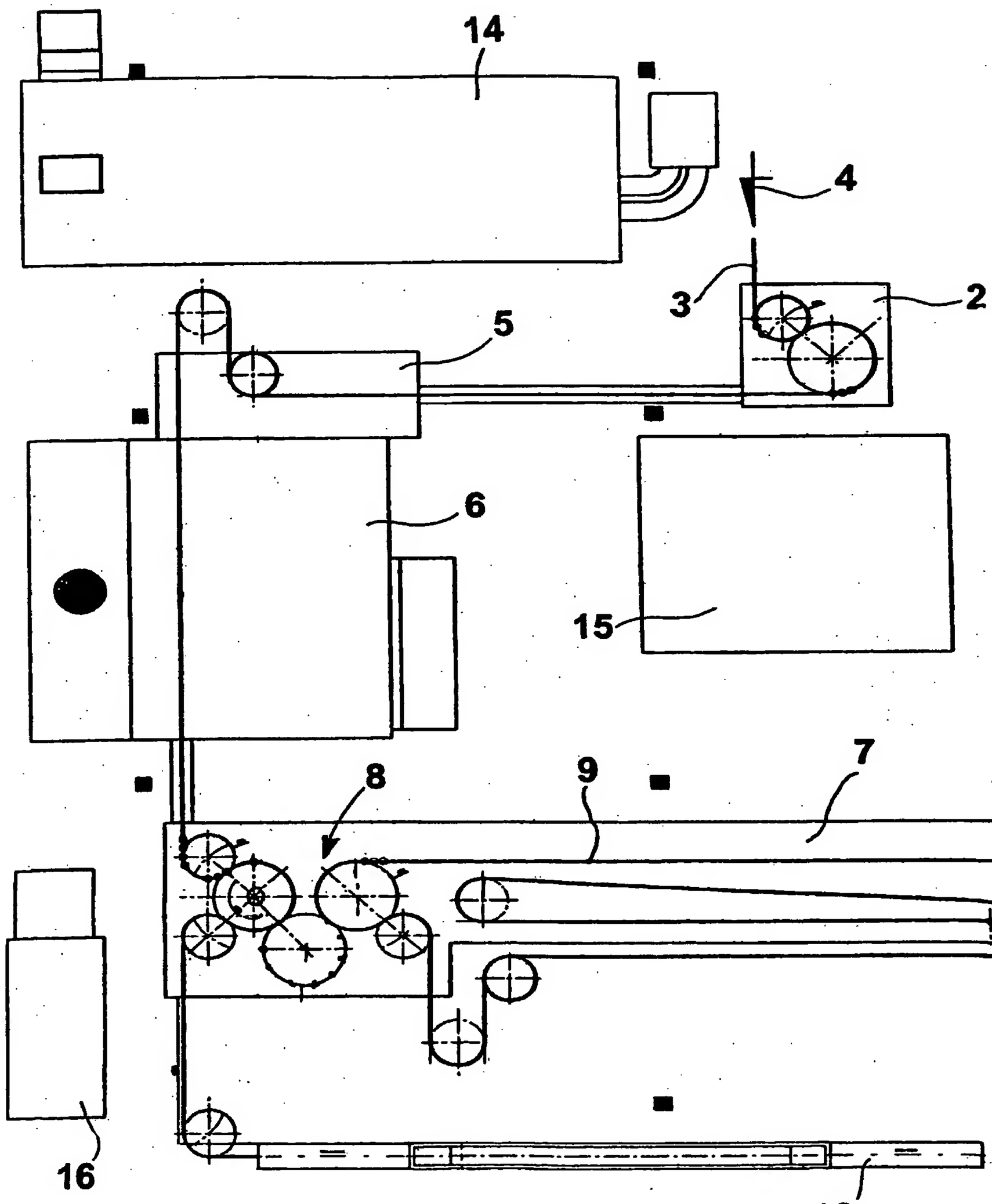

Fig. 5

INTERNATIONAL SEARCH REPORT

Inter al Application No
PCT/EP 03/02096

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B05B13/02 B05C9/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B05B B05C F16B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	column 7, line 65 -column 8, line 40 column 9, line 8 - line 56; figures ---	6,8,9
X	GB 2 323 069 A (MCCORMICK PATRICK) 16 September 1998 (1998-09-16)	1,2,5,7
A	page 12, line 25 -page 13, line 25; figures 1,2 ---	8,9
X	US 5 285 801 A (KLAUS KLENK) 1 February 1994 (1994-02-01)	1,7
A	column 4, line 49 -column 5, line 13; figures 1,2 --- -/--	8,9

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 May 2003	27/05/2003

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

Inter	Application No
	PCT/EP 03/02096

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	column 2, line 48 -column 3, line 42; figures	6,8,9
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A	page 2, line 66 -page 3, line 25; figure 1	8,9
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